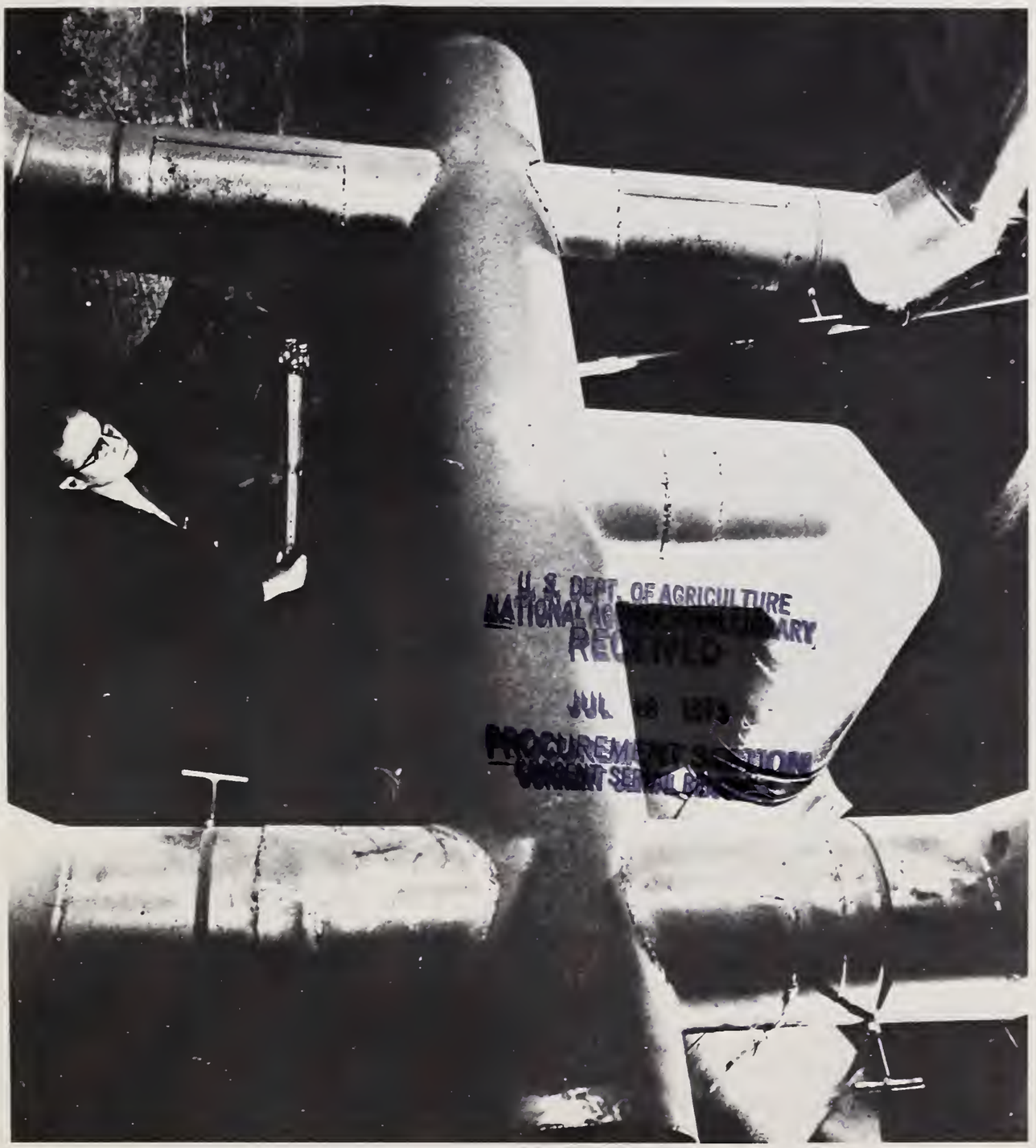
agricultural research

U.S.DEPARTMENT OF AGRICULTURE JULY 1973



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July 1973/Vol. 22, No. 1

Genetic Vulnerability

A remarkably small number of plants feed mankind. On a global basis, five crop species—rice, wheat, corn, sorghum, and barley—account for some 60 percent of the human caloric intake, with 25 percent coming from rice alone. It is thus a matter of concern that our major crops have increasingly become genetically vulnerable to attacks by pests and diseases.

Crop epidemics are as old as history. The most recent record, for example, includes the ravages of the potato blight in Ireland during the 1840s, the coffee rust of Ceylon in the 1870s and, in this country, the wheat stem rust of 1954 and the southern corn blight of 1970. In modern times the risk of epidemics has increased greatly as agriculture—responding to demands of consumers and the marketplace—creates vast monocultures wherein billions of plants of a single crop species sweep across thousands of acres, the plants all genetically similar. The narrowness of this genetic base helps make possible today's high crop yields. Should a genetically uniform variety become susceptible, however, a bounteous banquet may ensue for pest or pathogen. Man would lament yet could survive the loss of a cultivated crop such as coffee. But the loss of rice, wheat, or corn, many observers note, would be as devastating to civilization as atomic warfare.

Plant scientists, faced with these genetic threats to crops, already bear an awesome responsibility in helping feed the world's burgeoning population. Of the steps they can take to safeguard our crop heritage, three loom particularly important. First, to obtain germ plasm for genetic diversity, plant scientists must vigorously collect or conserve still existing plantlife—including the wild progenitors of our cultivated crops—before they are gone forever. Second, these plants must be maintained, either in world collections such as those of ARS, or in isolated preserves set aside and protected against genetic dilution by cultivated varieties. Third, they must breed and release varieties that incorporate a diversity of genes, enabling them to better withstand epidemics.

Plant scientists are in for trying times. Even with valiant exertions in fostering the genetic diversity of crops, the prospect for some years is for an uncomfortably close race between the stork and the plow. But with the know-how of agricultural science and public interest and support, neither crop plant nor man need become an endangered species.

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COVER: This high contrast photo shows Mr. Converse monitoring air flow at the U.S. Grain Marketing Research Center's pilot scale aeration system. The grain bins for this nearly commercial capacity plant are on the floor directly above (0573X423–3). See story on page 3.

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Earl L. Butz, Secretary
U.S. Department of Agriculture

Talcott W. Edminster, Administrator
Agricultural Research Service

With sampling probe, Mr. Converse extracts sample from test bin of high moisture corn stored under continuous aeration. Lab analysis of these samples will indicate moisture content, mold, and mold invasion (0573X422–4).

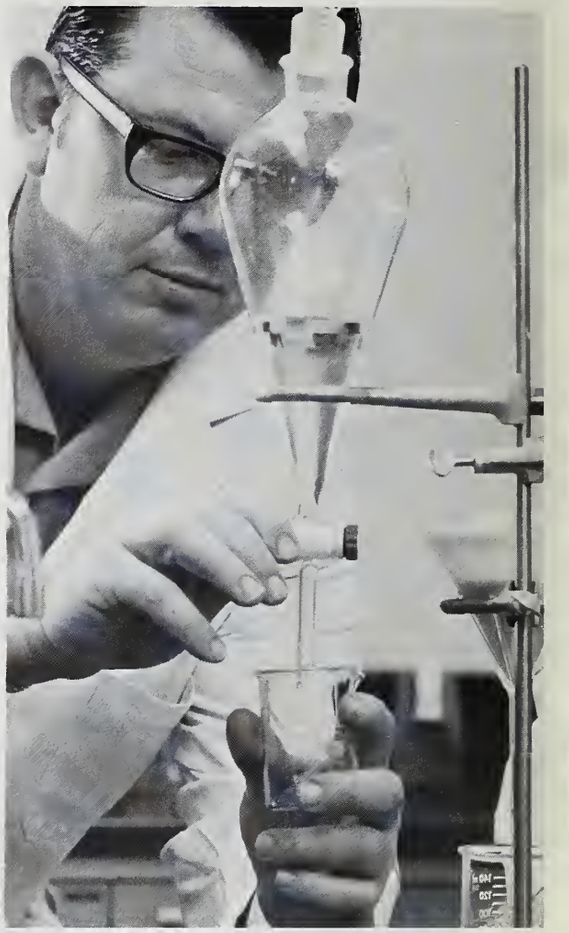
Aerating corn for short-term storage

AERATION as an alternative to drying high-moisture shelled corn, or for maintaining quality during short-term storage, should begin immediately after harvest.

ARS-Kansas Agricultural Experiment Station studies at Manhattan, indicate that a delay of 1 or 2 days in starting aeration can open the way for mold invasion and deterioration of quality.

Changes in farming practices have increased the amount of high-moisture corn harvested and have shortened the normal harvest season. As a result, corn often is delivered to farm and commercial dryers faster than it can be handled. In addition, some cattle feeders are using moist corn in fattening rations. Short-term storage of corn under aeration might be feasible in either situation.

In consecutive 1-year tests, agricultural engineer Harry H. Converse and



Above: *To test aerated corn for the presence of aflatoxin, research chemist Larry Seitz separates impurities from corn extract (0573X424–2).* ***Left:*** *Dr. Sauer and research assistant Rosemary Burroughs observe corn samples to determine the extent of mold invasion during storage (0573X426–5).*

plant pathologist David B. Sauer, U.S. Grain Marketing Research Center, and Kansas agricultural engineer Teddy O. Hodges compared immediate and delayed aeration with refrigerated air as well as immediate aeration with natural air. Earlier ARS research suggested that use of refrigerated air might be practical in localities where hot weather is common at harvesttime.

Each of the tests involved 150-bushel lots of corn harvested at 21- to 22-percent moisture content. Aeration with refrigerated air (0.5 cubic foot per minute per bushel) began immediately, 20, and 40 hours after harvest to cool and

Above: Scientists at the U.S. Grain Marketing Research Center study the relationship of germination to mold growth and storage environment (0573X425–14). ***Right:*** *Mrs. Burroughs adjusts bisecting microscope to determine numbers and kinds of fungi in corn from storage tests (0573X462–8).*

hold corn at 35° to 45° F. in insulated bins. With continuous natural air aeration at the same rate, grain temperature fluctuated in response to changes in outdoor air temperatures.

The researchers found that grain temperatures increased 0.5° F. per hour the first year, and 0.35° F. the second during delays between harvest and aeration. A higher percentage of broken kernels and higher initial mold populations apparently explain the more rapid rise in grain temperature the first year.

During both years, average moisture content of corn in the top 2 feet of the bins—the last corn to dry—was reduced to 16 percent in 18 to 20 weeks with refrigerated air, and to 14 to 15 percent in 12 weeks with natural air.

Essentially no mold growth occurred either year in corn cooled immediately with refrigerated air. When aeration was delayed, however, the average percentage of kernels invaded by *Aspergillus flavus* at the end of 1 week was 50 percent with 20-hour delay and 87 percent with 40-hour delay the first year, and 6 percent and 3 percent with the same delays the second year. After 1 week of aeration with natural air, the corresponding percentages were 13 percent and 5 percent but *A. flavus*, along with other molds, continued to increase during storage. (*Aspergillus* and *Penicillium* molds found in corn may produce mycotoxins.)

The grade of all test corn was No. 2 at the end of 5 months. With the exception of the grain receiving immediate refrigerated aeration, initial mold invasion probably would have produced grade changes in long-term storage. The scientists suggest that increasing the aeration rate with natural air from 0.5 and 1 cubic foot per minute per bushel would shorten drying time by half and possibly reduce mold activity during the early weeks of storage. □

The soybean: A nutritional paradox

THE nutritional superiority of heated over unheated soybean flour is well known. Heating imparts a beneficial effect by denaturing a toxic protein(s) called trypsin inhibitor. This inhibitor prevents the breakdown of protein by trypsin, a powerful pancreatic enzyme. Paradoxically, many of the functional properties—e.g. protein solubility—connected with essential soybean nutrients are better when soybeans undergo very little heat treatment.

Within the framework of this paradox, ARS-sponsored Israeli research has clarified some of the implications if *raw* soybeans are used in compounding food and feeds. In such cases, the functions of the amino acid methionine and of vitamin B_{12} are greatly impaired.

Dr. Carolyn D. Berdanier, ARS-cooperating scientist, Beltsville, Md., says the starting point in this Israeli study was the observation that feeding raw soybean flour (sbf) causes enlargement of the pancreas in chicks and rats. In view of the importance of the pancreas as a regulator of overall blood-sugar metabolism, the Israelis concentrated part of their research on these endocrine functions, using rats fed heated sbf as controls.

Their experiments showed that rats adapted to a raw sbf diet exhibited some deviations from normal carbohydrate metabolism associated with the pancreas. As compared to the controls, the rats responded to a glucose dose, used to test the insulin response of the pancreas, with a marked hyperglycemia (abnormally high blood-sugar level) and a higher concentration of glycogen (liver-stored carbohydrate). Also, their pancreases released more insulin-like activity (ILA).

The increased release of ILA and the enhanced accumulation of liver glycogen could be explained in terms of stimulation of insulin secretion by the trypsin inhibitor present in unheated sbf. However, this possibility seems incompatible with the hyperglycemic response to the glucose dose. Apparently, the aberrations in carbohydrate metabolism resulted from the raw sbf-adapted rats consuming 40 percent less food than did the controls.

It was a case of appetite loss, because when the control animals' food intake was restricted to the same extent and these animals were given the glucose test, their carbohydrate metabolism was the same as that of the rats fed raw sbf.

In their work on methionine and vitamin B_{12}, the Israelis found that feeding raw sbf increased the requirement for this vitamin. Called the anti-pernicious anemia vitamin, B_{12} is synthesized in the gut of the rat by intestinal micro-organisms. By injecting radioactive B_{12}, the Israelis were able to trace the vitamin activity and found that it was excreted faster and was absorbed less by rats fed raw sbf as compared to the controls.

The relationship of methionine to vitamin B_{12} is tenuous. It was concluded, however, that the known deficiency of methionine in both raw and heated soybeans could account for the B_{12} deficiency, because the microorganisms in the gut require this amino acid to grow.

One possible spin-off from the Israeli study is the finding that rats fed unheated sbf suffer from some underactivity of the thyroid gland. The determination in raw sbf of the presence and activity of the soybean goitrogen might lead to a product useful to physicians for treating hyperthyroidism.

This Public Law 480 project was conducted under the direction of principal investigator, Dr. Karl Guggenheim, at the Hebrew University-Hadassah Medical School, Jerusalem. □

It's "open wide" for this rooster as Dr. Coria performs virus isolation using a tracheal swab (0573X440–6).

Inactivated virus may protect poultry

An inactivated virus vaccine may be safer to use and as effective as live-virus vaccines now in use to protect chickens against avian infectious bronchitis (AIB).

Because the vaccine is prepared with inactivated virus, its use would eliminate the chance for accidental spread of bronchitis from vaccination with the modified live virus. Its use might also reduce the amount of synergistic reactions from multiple infections commonly found in present live-virus immunization programs.

AIB, a highly contagious infection of the respiratory tract of chickens, costs poultry producers millions of dollars annually in lowered egg production and setback of growth in young birds. Once the disease is introduced into a flock, it may persist in a latent form capable of producing an outbreak when conditions are right.

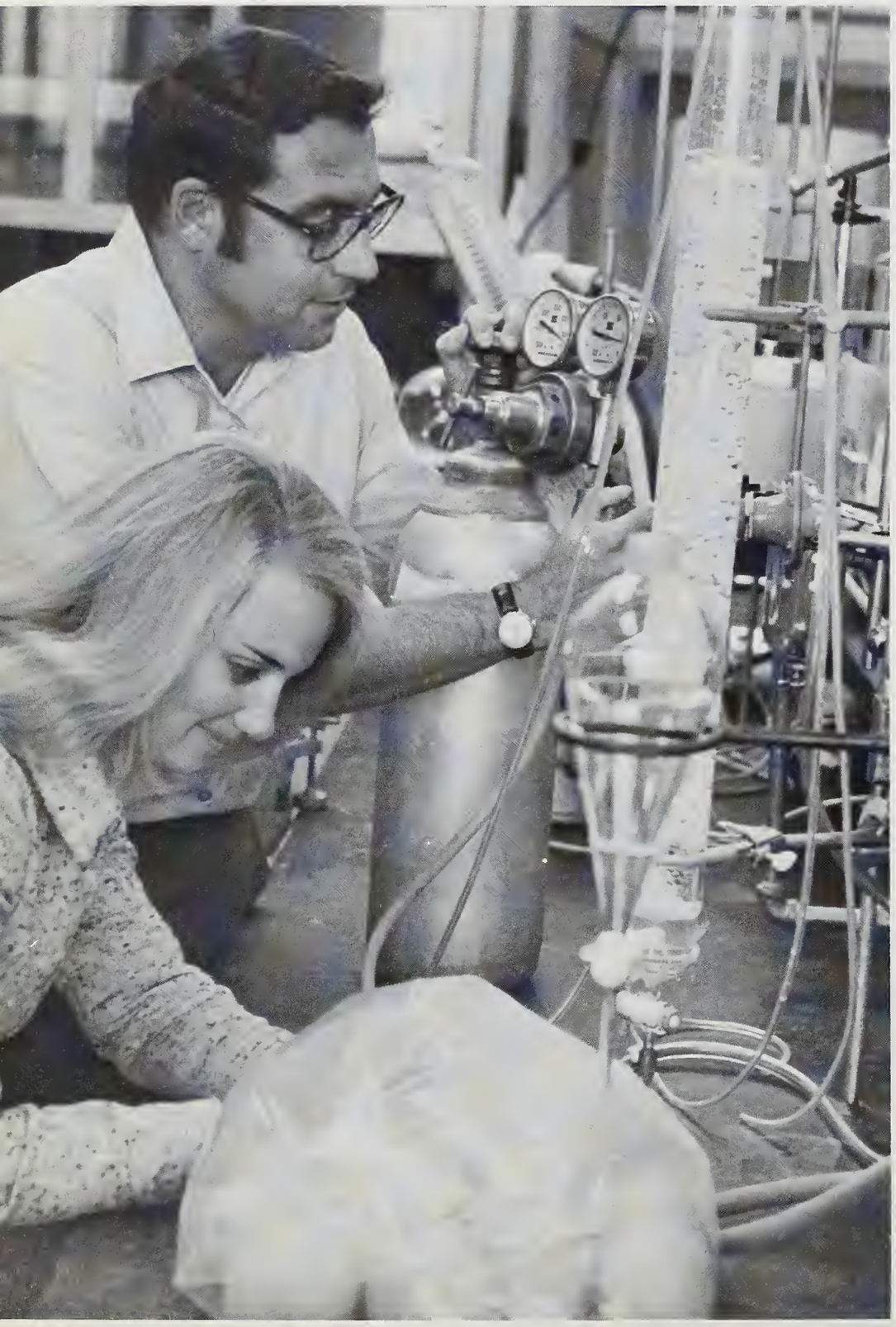
In tests at the National Animal Disease Laboratory, Ames, Iowa, microbiologist Manuel F. Coria administered the vaccine by an aerosol. Presently used vaccines are administered in the birds' drinking water. Aerosol vaccination of human subjects has provided immunization equally effective as subcutaneous or intramuscular vaccination with inactivated influenza viruses, thus suggesting that the aerosol method might have similar results in protecting chickens against respiratory diseases.

Dr. Coria prepared the vaccine from the Connecticut strain of virus. He administered the beta-propiolactone-inactivated virus in two doses, 3 weeks apart.

He challenged the immunity of the birds with the Massachusetts strain 2 to 4 weeks after the second aerosol exposure. Vaccinated birds were negative for virus isolation, while unvaccinated birds were 80 to 100 percent positive for the same post-challenge test period.

Research, so far, indicates that the inactivated virus is effective in preventing primary infection of the trachea and, it would reduce the possibility of latent AIB infections in chickens immunized with live-virus vaccines. □

Debittering process sweetens citrus juice



DELAYED BITTERNESS in citrus juice and other citrus products can be reduced with the recent development of a metabolic debittering process.

The bitterness problem does not arise in fresh citrus juice or in whole fruit if it is consumed shortly after juice extraction. At this time, the bittering agent, limonin, has not had a chance to form.

Limonin is produced from a nonbitter substance in fruit tissues—limonoate A-ring lactone (LARL)—that when mixed with acids during juice extraction becomes an intensely bitter substance, even in small amounts. The problem is particularly acute with navel oranges, however, it does occur at times with all types of citrus.

Earlier studies showed that juice from late-season navel oranges tended to be less bitter than that from early-season fruit. The low bitterness levels did not show up, however, until late in the season after much of the crop had been harvested.

Until now, no practical method to remove limonin had been found but research into the chemistry and biochemistry of the material over the past several years led chemists Vincent P. Maier, Linda C. Brewster, and Andrew C. Hsu, Pasadena, Calif. to the metabolic debittering approach to the problem.

These researchers are well on the way to commercializing a process for debittering by treating fruit with ethylene gas before the fruit is juiced, or other procedures involving disruption of fruit tissues.

In the ARS study, fruit were exposed to ethylene gas—20 parts per million (ppm)—for 3 hours and then held in the absence of ethylene for 5 days. The

juice from the treated fruit has 30 to 50 percent lower limonin concentration than the juice from untreated fruit. In addition, the limonin content of the 3-hour ethylene treated fruit was essentially identical to that of companion fruit continuously exposed to ethylene for 5 days. Longer treated fruit, while almost identical in limonin content as shorter treated fruit, were subject to potentially undesirable changes—such as off-flavors—associated with prolonged accelerated respiration.

Metabolic debittering does not remove limonin but more or less short-stops its formation by accelerating the metabolism of LARL. This destroys the LARL to a point where its concentration compares with that in late-season fruit.

The debittering process is relatively inexpensive and simple to perform since existing facilities at fruit packinghouses can be used. Once the 3-hour ethylene treatment is completed, the fruit can be held in bins, truck trailers, or any available receptacle either indoors or outdoors. Transit time from the packinghouse to the processing plant would provide part of a 5-day holding period between the ethylene treatment and juicing.

Another promising metabolic accelerator under study is 2-chloroethylphosphonic acid (CEPA) that is known to produce numerous physiological effects for regulating plant development (AGR. RES., Nov. 1970, p. 5).

The CEPA treatment holds special promise as a method of promoting metabolic debittering because of the ease of treating the fruit. The CEPA solution can be conveniently applied by spraying or dipping the fruit at the packinghouse after they are separated from the fresh market fruit.

CEPA, however, cannot be used for metabolic debittering at the present time since it requires Food and Drug Administration approval for use on citrus. (CEPA has recently been cleared for use on cherries and tomatoes.) The toxicological studies needed to obtain clearance of CEPA are currently in progress. □

Above: *Chemist Linda Brewster determines results of the debittering treatment by thin-layer chromatography comparisons of the juice from treated and untreated fruit (473X399–27).*

Far left: *Dr. Maier and Ms. Brewster prepare to treat navel oranges with 20 ppm ethylene for 3 hours to reduce the amount of limonin which would form after the fruit were juiced (0473X399–1).*

Below: *A gas sample is taken from the interior of a treated fruit. The 3-hour ethylene treatment causes an increase in the internal ethylene concentration of the fruit while the CO_2 concentration remains at the normal level during most of the holding period (0473X403–23).*

Right: *Mr. Durkee pours salt slurry into the salt reclamation incinerator (0371X220–8).*
Below: *This submerged combustion chamber has concentrated the brine into a slurry Mr. Durkee then removes the slurry from the bottom of the chamber (0871K1002–30).*
Far right: *After the incineration process, the slurry is reduced to salt crystals. (0871K1002–13).*

Packing pickles with recycled brine

DISPOSAL of pickling brine has become a serious concern for California's pickle and olive packers. Proposed legislative standards for disposal of saline liquid waste would severely limit dumping into water. It is the corrosive nature of the sodium chloride (NaCl) salt in the brine, and the nature of the nonbiodegradable salt and organic solids that make disposal particularly difficult.

Engineers at ARS' Western regional research laboratory, Berkeley, Calif., have developed a successful method for reclaiming the salt from pickling brine, thus keeping it out of the effluent stream.

The heart of this new process is a submerged combustion evaporator which crystallizes the salt from the used brine solution. In submerged combus-

tion, the gaseous products of combustion pass directly up from the burner through the brine. Heat is rapidly transferred from the rising gas bubbles directly to the brine through the bubble interface. Because the partial pressure of the water vapor in the rising bubbles is less than 1 atmosphere, boiling takes place at 227° F., considerably below the normal boiling point for a saturated NaCl solution.

Now the condensed brine, changed to a slurry, leaves the bottom of the evaporator. It contains about 58 percent solids of which about 6 percent is combustible organic matter that must be eliminated before the salt is suitable for reuse.

These organic contaminants are destroyed by incineration for 5 minutes at 1200° F. Then the salt is decontaminated except for a small amount of carbon and is ready for storage.

To prepare next season's pickling brine, the salt is dissolved in water and the carbon removed by simple filtration. This same salt can be reused for five or more seasons.

The laboratory's pilot plant model was so successful that an equipment manufacturer in Dresher, Pa., is now marketing a brine disposal and salt recovery system. This system is based directly on the results of research conducted by ARS engineers Edison Lowe and Everett L. Durkee at Berkeley.

The engineers state that not only might brine disposal problems be eliminated, but the equipment pays for itself by recovering the reusable salt. □

Inert atmosphere vs. stored grain pests

DENY AN INSECT life-supporting oxygen long enough and it will die.

This basic biological principle is exploited in a promising new way to control insects in stored grain. The method involves replacing the normal atmosphere in a closed storage structure with an atmosphere containing less than 1 percent oxygen.

The inert atmosphere is created by piping the exhaust from exothermic inert atmosphere generators into the grain storage tank. The generators are sophisticated "big burners" originally designed for industrial use. They operate under controlled pressure with almost complete combustion. The end product, or inert atmosphere, after moisture removal is less than 1 percent oxygen, 8.5 to 11.5 percent carbon dioxide, and the balance principally nitrogen.

Studies conducted by ARS entomologist Charles L. Storey in cooperation with the Kansas Agricultural Experiment Station, Manhattan, mark the first reported use of the generators in insect control. The feed industry employs the generators to preserve vitamin A content, color, weight, and palatability of alfalfa pellets.

Initial tests by Mr. Storey at a commercial grain storage facility at Hastings, Nebr., demonstrated the ability of the generators to create an inert atmosphere in stored grain and the potential value of this pesticide residue-free method as an alternative to conventional fumigation.

Mr. Storey conducted the studies in a 130-foot-high concrete elevator tank containing about 20,000 bushels of wheat. He used two generators, each capable of generating 15,000 cubic feet of inert atmosphere per hour. Screened cages containing adult confused flour beetles or wheat infested with immature stages of the rice weevil were placed at air-sampling points within the tank before it was filled with wheat.

Oxygen concentrations of less than 1 percent for 24 hours killed the adult flour beetles. Exposures of 72 to 96 hours were not effective against immature stages of the rice weevil. Research is continuing to determine the susceptibility of the rice weevil throughout its development cycle as well as the length of treatment needed to control all stages of this and other important stored-grain insects.

In the most effective test, the grain tank was purged overnight before filling by introducing the inert atmosphere through 1½-inch pipes. The overnight treatment resulted in oxygen concentrations ranging from 2.4 percent in the bottom of the tank to 4.3 percent at the top. After filling, the oxygen reading was less than 1 percent below the 110-foot level and near normal at the top. Within 8 hours after filling, the oxygen concentration was less than 1 percent throughout the grain mass.

Wheat germination tests made by the Kansas State Board of Agriculture, grade determinations by USDA's Agricultural Marketing Service, and milling and baking tests by ARS and Kansas grain scientists indicated no significant difference in quality between treated and untreated wheat. Neither were significant changes in grain temperature or moisture content detected after 72- to 96-hour treatments.

Further research is needed to modify exothermic inert atmosphere generators for insect control and to determine equipment and operating costs under commercial conditions. □

Natural-based lubricants pass the test

LUBRICANTS made with natural oils and fats are making a comeback.

Vegetable oils and animal fats have a long, historical record as lubricants. But as mechanization progressed and lubricant demands increased, the time-proven vegetable and animal based lubricants have been relegated more and more, for reasons of cost, availability, and the advent of petroleum, to the role of additives for petroleum based lubricants.

This, together with the increasing severity of the performance requirements for lubricants resulted in an intensive search for improved lubricants and additives that would meet today's needs.

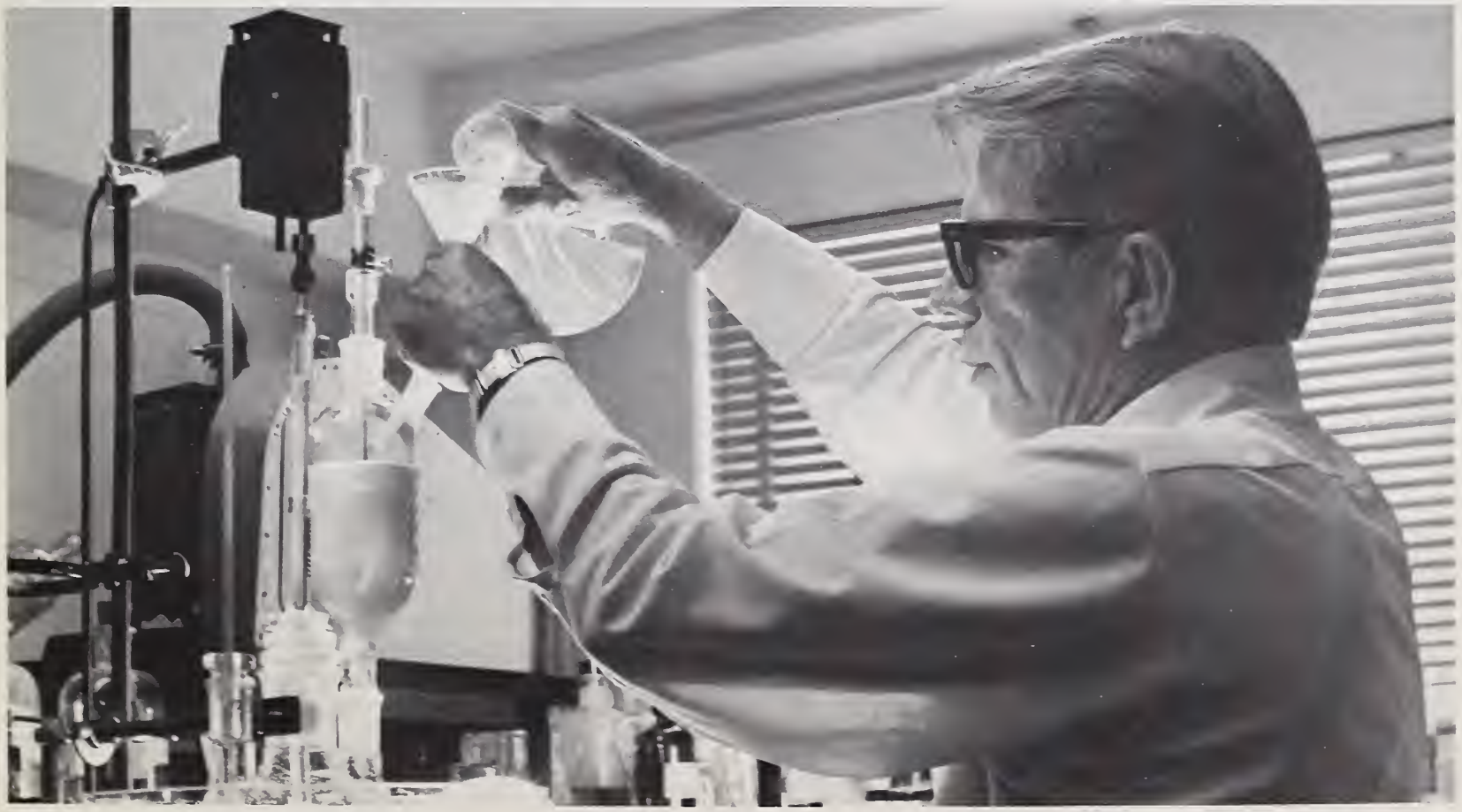
Recent research at the ARS Southern and Eastern regional research laboratories in New Orleans and Philadelphia indicates that certain fatty acid amides and their derivatives show marked potential as lubricants and lubricant additives. The amides are long-chain compounds derived principally from oleic acid, plentiful in animal fats and in many vegetable oils.

Some of the derivatives, notably those containing chemical groups known as epithio and diepithio, were especially promising. Used as neats—that is, by themselves—they were superb lubricants, although for most applications their cost would make them prohibitive. They could be added at the 5 to 10 percent level to improve the performance of other lubricants such as paraffins, diesters, or silicones.

A four-ball extreme pressure test was used to determine the lubricity of these compounds, both as neats and as additives. In this test, an oil sample is poured into a cup containing three stationary steel balls spaced close together to form a triangle. The cup assembly is placed into the tester where a fourth ball, rotating at 1,440 revolutions per minute is brought into contact with the other three under pressures up to 600 kilograms (kg). The test is run without external heat for 1 minute or until the lubricant fails, resulting in a welding together of the balls. Successive runs are made, starting at a pressure the sample will stand for 1 minute, then increasing the pressure in subsequent runs until the balls weld within the test period. This is the lubricant's weld point.

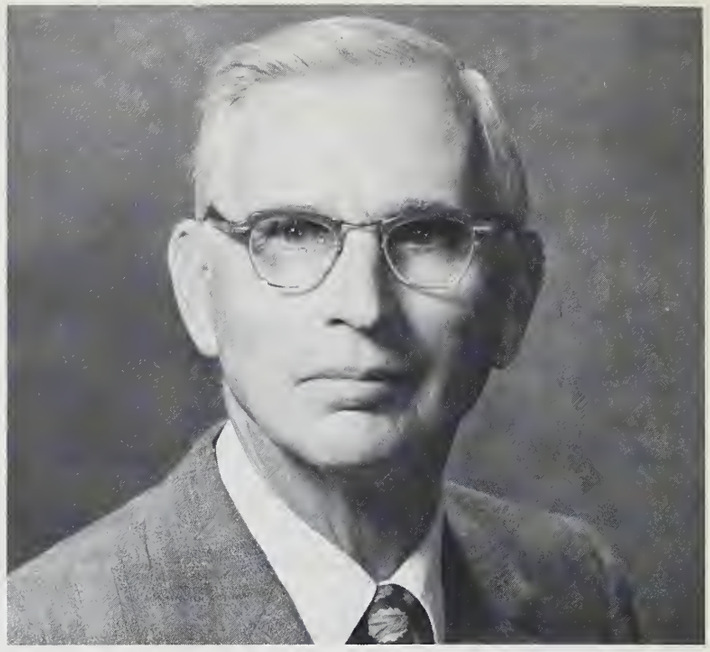
Some of these experimental fatty lubricants had weld points well in excess of 280 kg, the rating for SAE 90 commercial automotive transmission fluid. For the epithio derivatives tested as neats, weld points of 400 kg were fairly common. Two of the diepithio compounds were 600 kg and more. Paraffin or diester oils with 5 to 10 percent epithio derivatives often exceeded 200 kg in their weld points, and some were as high as 350 kg. □

Chemist Frank C. Magne adds epoxides to a mixture of sulfuric acid, thiourea, and water to make an extreme pressure lubricant from vegetable oil (PN–2835).



SCIENTISTS HONORED

For their outstanding achievements, seven individuals and four groups of ARS employees recently received Distinguished and Superior Service Awards. Secretary of Agriculture Earl L. Butz presented the awards at USDA's 27th annual awards ceremony held May 22 in Washington, D.C.



Research horticulturist John H. Weinberger (BN–4210).

for Distinguished Service:

Talcott W. Edminster, ARS Administrator, Washington, D.C., for leadership in guiding ARS through a successful reorganization, while assuring continued progress in research programs during the transition.

John H. Weinberger, research horticulturist, Fresno, Calif., for development of superior commercial types of fruits which have received national and international recognition by horticulturists, fruit breeders, and commercial growers.

Aircraft Disinsection and Quarantine Treatments Unit, Beltsville, Md., for organizing, directing and conducting research in a multidisciplinary effort resulting in highly effective, environmentally safe quarantine treatments used internationally against insects dangerous to agriculture and public health. Headed by William N. Sullivan, the team also includes Charles M. Amyx and Milton S. Schechter.

for Superior Service:

Hilary D. Burton, computer systems analyst, Beltsville, Md., for implementing a computer based literature searching service resulting in a direct cost avoidance of $500,000 annually.

William G. Hart, research entomologist, Weslaco, Tex., for pioneering the development of the infrared aerial color photography technique for determining the presence and density of insect infestations.

Walter A. Pons, Jr., research chemist, New Orleans, La., for developing new, highly sensitive quantitative and extremely rapid, qualitative methods for determining aflatoxins in feeds and food products.

Walter H. Wischmeier, research investigations leader, Lafayette, Ind., for meritorious leadership in conceiving, developing, and improvising an internationally accepted erosion equation for applying soil-conserving practices to approximately one million farms and construction sites subject to water erosion.

Elmer B. Hudspeth, Jr., agricultural engineer and **Levon L. Ray,** geneticist, Lubbock, Tex., for developing suitable varieties, equipment, and methods to produce and harvest high-population cotton.

Oxidation of Flame Retardant Cotton Team, New Orleans, La., for research leading to the stabilization and durability to sunlight and repeated laundering of phosphorus-based flame retardant finishes on lightweight fabrics. Headed by Wilson A. Reeves, the team also includes: John V. Beninate, Ralph J. Brysson, Albert S. Cooper, Jr., Donald J. Daigle, George L. Drake, Jr., James E. Hendrix, Laurence W. Mazzeno, Jr., Rita M. Perkins, Brenda J. Trask, and David A. Yeadon.

Insect Physiology Laboratory, Beltsville, Md., for pioneering research on the hormones and other biological regulators of insects that has provided new approaches to the development of safe and selective chemicals for insect control. Headed by William E. Robbins, team members also include: William S. Bowers, Charles F. Cohen, Samson R. Dutky, John N. Kaplanis, Thomas J. Shortino, James A. Svoboda, and Malcolm J. Thompson.

Waste Water Renovation Group, Phoenix, Ariz., for renovating municipal waste water by land application systems to reduce pollution of surface water and to yield renovated water for reuse. Headed by Herman Bouwer, team members also include: Richard G. Gilbert, James C. Lance, Robert C. Rice, and Frank D. Whisler. □

Insect control with microwaves?

CONTROL of insects in stored grain with microwave or radiofrequency (RF) electric fields, an environmentally acceptable approach that leaves no harmful chemical residues, is possible although currently not economically feasible.

Agricultural engineer Stuart O. Nelson points out that stored-grain insects absorb energy from RF fields at a faster rate than the grain. This selective heating offers advantages over more conventional types of heating.

Dr. Nelson's studies, in cooperation with the Nebraska Agricultural Experiment Station, Lincoln, indicate that the most promising RF frequencies lie in the range between 10 and 100 megahertz (million cycles per second). The adult stage of the rice weevil, granary weevil, and lesser grain borer proved more susceptible to control when exposed in infested wheat than did the immature forms. Larval and adult susceptibility varies among species and sometimes with the age of larvae or adults.

Much larger investments in equipment would generally be required for RF heating systems than for chemical fumigation, Dr. Nelson points out, noting that costs change with time and developing technology. RF treatment might be feasible if the equipment were also used to improve seed germination or to accelerate grain drying.

Nutrient data available

PUNCHED CARDS and magnetic tapes containing food composition data are now on sale.

These materials were developed by the ARS Consumer and Food Economics Institute. They are available for use by people in food science and the food industries, and by dietitians, nutritionists, and consumers in need of data on the content of nutrients in raw, processed, and prepared foods.

Data set 72–4–0, taken from Home and Garden Bulletin No. 72, "Nutritive Value of Foods," is available on one magnetic tape for $25. Data sets 8–1–0, 8–2–0, and 8–3–0, based on Agriculture Handbook No. 8, are available on another magnetic tape for $28.50.

Two new data sets, 8–1–1 and 8–2–1, are also for sale on a single magnetic tape. for $30. Expanded from tables 1 and 2 of Agriculture Handbook No. 8, they also include values for a few additional foods, values for cholesterol for all foods, and imputed values for dashes and footnotes in the published tables.

Each of the six data sets can also be purchased on punched cards, costing from $10 to $38 for a single set. Postage is extra for both the tapes, which weigh 5 pounds each, and the cards, which weigh from 4 to 50 pounds for each data set.

Requests for order forms and orders are to be sent directly to the supplier: Dynamic Data Services, Inc., 8055 13th St., Suite 310, Silver Spring, Md. 20910.

Inquiries about data should be addressed to: Consumer and Food Economics Institute, Agricultural Research Service, U.S. Department of Agriculture, Room 329, Federal Center Building #1, Hyattsville, Md. 20782.

Light helps embryo growth

EXPOSING fertilized eggs to fluorescent light from the fifth to the fourteenth day of incubation produces heavier embryos on any given day than those obtained from nonilluminated eggs. Egg size has no effect upon embryo weight during the period of incubation.

These are findings of a study conducted because illuminated eggs were known to hatch sooner, but it was not known if this was caused by an accelerated rate of embryonic development. The experiment was conducted by ARS geneticists Vernon A. Garwood and Phillip C. Lowe in cooperation with the Purdue University Agricultural Experiment Station, Lafayette, and poultry scientist Erly J. Thornton of Tennessee State University, Nashville.

Embryos exposed to light in the experiment required an average of 20.6 days to hatch compared with 21.5 days for those that were not exposed. Rates of embryonic weight gain for the two treatments increased differentially.

Observations from the experiment substantiates work of other scientists who reported, in conflict with other reports, very small correlations between embryo weight and egg weight from the fourth through the fourteenth day of incubation.

New light on MD transmission

TRANSMISSION of Marek's disease (MD) from hen to chick via the egg occurs infrequently, if at all, even when the egg contains blood or meat spots and comes from a flock experiencing 4 to 10 percent death loss monthly from the disease.

ARS microbiologist John J. Solomon and veterinary medical officer Richard L. Witter obtained eggs from two commercial flocks, one protected against Marek's disease by vaccination and one unprotected. Eighty-seven percent of the birds in the unprotected flock carried MD virus in the blood when tested 5 weeks after egg collection.

None of the 86 chicks hatched from eggs containing blood, meat spots, or both kinds of spots, showed evidence of MD lesions or mortality during the 10 weeks they were reared in isolation. Neither did the surviving chickens have the antibody to MD, and no MD virus was recovered by assay on duck embryo fibroblast cultures.

Similarly, there was no indication of MD virus, antibody, or lesions in 80

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chicks hatched from normal eggs from the same flocks. These results reinforce earlier findings by Dr. Solomon and Dr. Witter at the Regional Poultry Research Laboratory, East Lansing, Mich. (AGR. RES., Sept. 1970, pp. 12–13.)

The risk of congenital transmission via occasional eggs containing blood or meat spots under commercial conditions cannot be excluded, the scientists conclude, but it does not appear to be an important consideration.

The Michigan Agricultural Experiment Station, East Lansing, cooperated in the studies.

Low-cost peripheral circulation

A low-cost air circulation system adapted to older houses has proved effective in distributing draft-free heat evenly throughout the rooms, regardless of the heat-producing equipment used. This blower-driven system works with a pot bellied stove as well as with a furnace, baseboard heaters, or radiant panels.

The feasibility study was conducted by agricultural engineers Jerry O. Newman of the ARS Agricultural Research Center, Beltsville, Md., and Homer T. Hurst, Virginia Polytechnic Institute and State University, Blacksburg, Va.

Peripheral circulation is sometimes installed in new houses as part of the central heating unit. The great majority of American families still live in older houses, however, and need some kind of air circulation system that can be used with existing heating facilities. With this need in mind, the two engineers adapted, installed, and evaluated the peripheral circulation system in an older house without central heating. Installation required about 22 hours of unskilled labor and cost under $50 in materials. Figures will vary depending on house size and equipment needed.

Use of this method greatly reduced the wide variations of temperature in the house to a tolerable range of 5° to 7° F. Also, the damp, unsanitary crawl spaces that are characteristic of most older houses were effectively dried out and kept in good condition, so long as the warm air circulation was maintained.

Basically, the system works by forcing all the air in a house to move in a definite pattern. A blower pulls the air into a centrally located duct near the ceiling. This air is mixed to uniform temperature, forced into a crawl space, and carried to any desired point under the floor. A continuous slot or a series of holes along all exterior walls allows the air to escape from the crawl space through the floor and back into the living area. A thin film of air flows alongside the outer walls and gradually moves toward the central duct for remixing and recirculation.

The engineers say that heat produced in *any* part of the house is uniformly distributed via the peripheral circulation system. This includes all excess heat from cooking, light bulbs, and electric motors. As a result, fuel is saved, kitchens are more comfortable, environments for appliances are cooler, and efficiency of refrigeration is increased.

The low cost and ease of installation of the system, plus its efficiency of operation, appear to make it a desirable means for improving substandard homes throughout the United States.

Work is continuing on adaptation of this air circulation system to houses of various sizes and designs.

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